Industrial pollution has 'held back' rainfall increases

1 July 2013 - Industrial pollutants have played a role in holding back increases in global rainfall which were expected with a warming climate, according to new research from the Met Office.

The paper, published in Nature Climate Change, explains for the first time why there has been no increase in global average rainfall over land during the last century despite a 0.8 °C rise in global average temperatures.

It concludes that total global rainfall could increase rapidly in future if temperatures continue to rise and sulphate aerosol emissions from industrial pollution decrease.

Peili Wu, lead scientist of the Met Office's Improving Hydrological Predictions Program and author of the paper, said: "This research uses best available observations and the latest climate models to suggest something quite surprising; that instead of there being no change in global rainfall, we see a detectable slow-down between the 1950s and 80s followed by an increase in global rainfall.

"These changes are related to sulphate aerosols from industrial pollution which directly reflect sunlight, helping to initially slow the cycle of evaporation and rainfall. After the clean air acts of the 1980s, that cooling effect was partially removed and the cycle began to speed up again."

The process of evaporation and subsequent rainfall, known as the hydrological cycle, is a key component of the Earth's climate system. Changes in this cycle have a direct impact on droughts, floods, water resources and ecosystems. Increasing levels of greenhouse gases - which increase the Earth's energy budget - would be expected to increase the pace of the hydrological cycle. This isn't what was observed, however.

In this research, Met Office scientists studied what has happened to the cycle and why it has not behaved as may be expected. They found evidence that aerosols were having a significant impact. The mechanism for this is related to the way rain forms from convection, where warm air at the surface rises through cooler air above - condensing the moisture in the air and producing rainfall.

Greenhouse gases increase temperature at the surface and higher up in the atmosphere, which should lead to an increase in rainfall overall due to the extra heat in the system. However, industrial pollution blocks short wave solar radiation from reaching the surface - so heating there is reduced compared to higher elevations. This means you end up with cooler relative temperatures at the surface, which reduce convection and rainfall. If aerosols are removed, convection increases and the hydrological cycle intensifies.

Peter Stott, the third co-author on the paper explained: "While these results are global and do not specifically address regional rainfall, we could see the drier regions of the earth get even drier as they see faster evaporation, while the wet regions get wetter as additional moisture in the atmosphere falls as increased rainfall."

This research continues developments in understanding the impact of aerosols, which have been possible due to the latest generation of climate models. Last week, Met Office research published in Nature Geoscience looked at how aerosols from industrial pollution have had an impact on the number of hurricanes in the North Atlantic.

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